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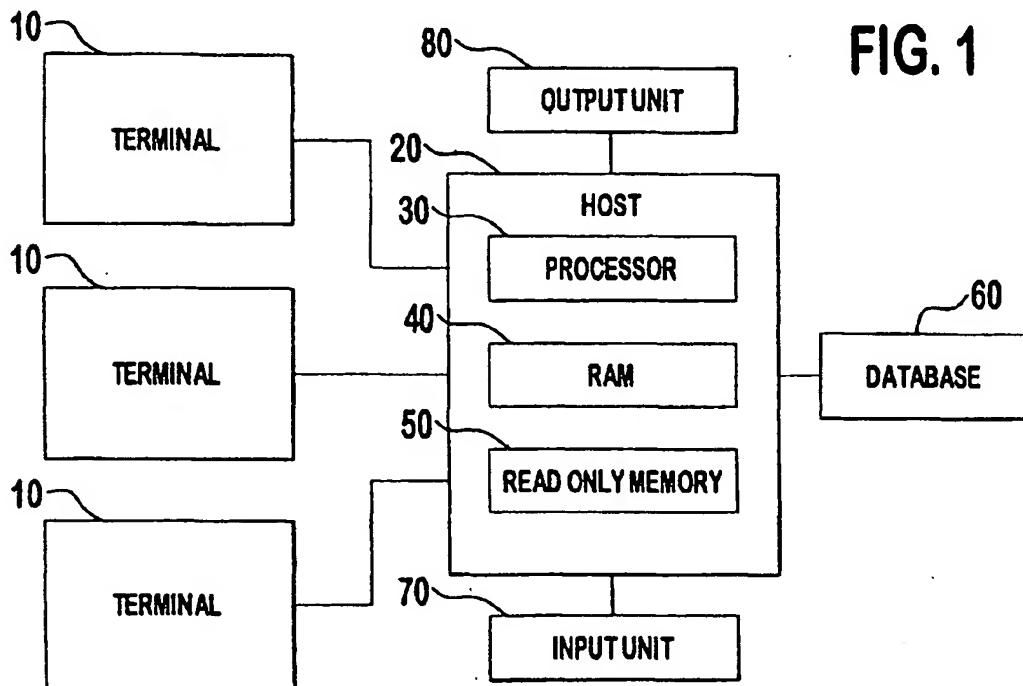
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(54) Biometric time and attendance system with epidermal topographical updating capability

(57) There is described a biometric time and attendance apparatus and method for scanning an epidermal portion of a human body, generating an epidermal topographical pattern and transmitting the epidermal topographical pattern to a host computer (20) for determining access privileges and for updating epidermal topographical database. Input to the computer is by means

of a plurality of terminals (10) which are connected to the host computer (20). Each terminal is placed at a location where access control is required. The host computer (20) includes a processor (30), RAM (40) and ROM (50). The host computer is also connected to an input unit (70), such as a keyboard, and an output unit (80), such as an LCD.



Description

[0001] The present invention relates to time and attendance devices. More particularly, the present invention relates to a biometric time and attendance device for scanning a portion of a human epidermis, generating an epidermal topographical pattern and transmitting the epidermal topographical pattern to a host computer for determining access privileges and for updating an epidermal topographical database.

[0002] Increasingly, security problems are becoming a more noticeable part of modern life. Security was once primarily the preserve of classified government installations, but increasing losses and calamity have forced the review of security equipment and procedures for government and industry. Property losses and the theft of corporate secrets cost industry billions of dollars annually. Public safety is endangered by the ability of intruders to easily enter secured places, such as aircraft and airport buildings, without detection.

[0003] Accordingly, access control and personnel identification are becoming the object of significant expenditures by organizations seeking to identify employees, vendors and others who are to be permitted access to secured areas.

[0004] Typical access control applications include: computer centers; radioactive or biological danger areas; controlled experiments; information storage areas; airport maintenance and freight areas; drug storage areas; apartment houses and office buildings; safe deposit boxes and vaults; and computer terminal entry.

[0005] Ascertaining the identity of an individual is a common problem for any access control application. There are three typically accepted ways of establishing a person's identity: (1) a personal identification code; (2) an encoded card having identification information; or (3) examination of a physical characteristic, such as a fingerprint. Since fingerprints and other epidermal topography are unique to an individual, they provide an extremely reliable identification characteristic. Fingerprint identification has been used for many years to help solve crimes, provide positive identification for security and help to identify missing persons. In addition, physical characteristics are practical for identification use because individuals do not ordinarily object to being so identified.

[0006] Devices are available to electronically scan epidermal characteristics and to produce related data signals which can be matched to stored images in a real time identification process. For example, U.S. Patent No. 4,210,899 discloses a fingerprint-based access control and identification apparatus which reads a human fingerprint and transmits the electronic representation of the fingerprint to a centralized image processing unit. The processing unit determines whether the individual whose fingerprint has been read is permitted access to certain areas at the specific time the fingerprint is read.

[0007] U.S. Patent No. 5,559,504 shows a device for performing fingerprint identification and continuous updating of the stored information. Each time a match is made, the device removes the prior data and stores the latest fingerprint pattern. The next fingerprint identification is performed by using the latest registered identification pattern. Identification information or an identification code is not required to update the fingerprint pattern stored in memory.

[0008] U.S. Patent No. 5,337,043 discloses an access control system which uses cards for storing data in the form of a barcode. The comparison of an individual's fingerprint with a fingerprint representation stored in a barcode is made directly at the access control point. The access control point decision to admit or deny access and a keyholder identifying code are sent in a report to a host computer. The time of day and the access control point location can be added to the report by the host computer. The system minimizes the contact of the intelligent terminal with the host computer rather than using a dumb terminal transmitting read data for processing by a host computer.

[0009] Although current systems provide rudimentary access control functions, there continues to be a need for an inexpensive method of controlling access to specified areas, accounting for changes in the epidermal topography in the data base, and providing a record of time and attendance of employees.

[0010] The present invention provides an epidermal topography based access control system which reads a portion of the human epidermis (e.g. a fingerprint). The system may include a plurality of terminals connected to a remote database storing epidermal topographical patterns and authorized access information. Each terminal scans a predetermined epidermis and generates an epidermal topographical pattern which is transmitted to a host computing device. The host computing device compares the transmitted epidermal topographical pattern with the stored epidermal topographical patterns. If a match is found, the host computer reads the information associated with the stored epidermal topographical pattern and determines whether access or egress at the current time is permissible. If no match is found, the terminal requests an authorization code. If an authorization code is entered and followed by a personal identification code, the individual seeking access may input a new epidermal topographical pattern to update the remote database.

[0011] For added security, each terminal may be equipped with a card reader or keypad for reading or entering additional identification information associated with the epidermal pattern data.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Figure 1 is a block diagram of an embodiment of

the present invention having multiple terminals; **Figure 2** is a diagram of a first embodiment of a terminal of the present invention; **Figures 3A and 3B** are diagrams of the steps of controlling access utilizing the terminal of the first embodiment of the present invention; **Figure 4** is a block diagram of a front face of a card; **Figure 5** is a block diagram of a rear face of a card; **Figure 6** is a diagram of a second embodiment of a terminal of the present invention; and **Figures 7A and 7B** are diagrams of the steps of controlling access utilizing the second embodiment of the terminal of the present invention.

[0013] The preferred embodiments are described with reference to drawing figures wherein like numerals represent like elements throughout.

[0014] **Figure 1** shows a possible configuration of a multiple terminal biometric time and attendance system with epidermal topography updating capability. A plurality of terminals **10** are connected to a host **20** which includes a processor **30**, a RAM **40** and a ROM **50**. The host **20** can be programmed to permit entry and/or egress (collectively referred to as access) for certain personnel based upon epidermal topographical patterns and access information. Access information includes a list of access control areas and times during which an individual is permitted to access an area. For example, an individual may be permitted access to controlled area "x" during the second shift. As such, the access information would include the permitted area(s) and the permitted time(s) for that individual. Since the access information is under the employer's control, the permitted area(s) and time(s) of access can be changed easily without the need for the issuance of a new identification card to the individual or getting updated access information to security personnel for manual verification. The host **20** has a data base **60** for storing the individual's epidermal topographical patterns and access information. The host **20** is connected to an input unit **70**, such as a keyboard, and an output unit **80**, such as a liquid crystal display. Each terminal **10** is placed at a location where access control is desired. This system enables access management for different personnel at different locations and times of day, or different days of the week or calendar days, etc.

[0015] **Figure 2** is a diagram of a first embodiment of a terminal of the present invention. The terminal **10** includes an epidermal topographical scanner **12**, a display **14** and a keypad **16**. An example of an epidermal topographical scanner **12** is a fingerprint scanner. The scanner **12** reads a portion of an individual's epidermis and generates an epidermal topographical pattern which is transmitted to the host **20** for comparison. Display **14** may display a final result for the request to gain access or prompt the individual for more information.

[0016] The operational flow of a first embodiment of the terminal **10**, which is preferably located outside of

the controlled area, is shown in Figures 3A and 3B. After the terminal **10** is activated, the program is started (**S1**) and the system is initialized, preferably automatically (**S2**). When an epidermis is detected (**S3**), the epidermal topographical scanner **12** scans the epidermis (**S4**), generates a digital epidermal topographical pattern signal (**S5**) and transmits that to the host **20** (**S6**). The host **20** compares the transmitted pattern with epidermal topographical patterns stored in the database **60** (**S7**).

[0017] If the transmitted epidermal topographical pattern of an individual wishing to gain access does not match one of the stored epidermal topographical patterns, access is denied (**S7A**), the host computer stores time of the attempt and generates a report (**S7B**). The display prompts security personnel to make a personal review or investigation of the individual. If it is determined that the individual should gain access, the security personnel proceeds to input an authorization code (**S11**). After an authorization code is entered and followed by the individual's personal identification code, the individual then places the predetermined epidermis, preferably a finger, on the epidermal topographical scanner **12** (**S12** and **S13**). The epidermis is read and a new epidermal topographical pattern is generated (**S14**). The new epidermal topographical pattern is transmitted along with the personal identification code to the host **20**, which stores the new epidermal topographical pattern with the personal identification code of the individual (**S15** and **S16**). Thus, the database **60** is updated and the system returns to step **S3**. If an authorization code is not entered, the system returns to step **S3**.

[0018] If the transmitted epidermal topographical pattern matches an epidermal topographical pattern stored in the data base **60** and the access information associated with the stored epidermal topographical pattern permits entry or exit, access is granted (**S7, S8 and S9**) and then the system returns to step **S3**. If there is a match and the access information stored with the epidermal topographical pattern does not permit entry or exit, access is denied (**S8 and S10**) and the system returns to step **(S3)**. Each time an individual is denied (**S10**), the host **20** preferably stores the time of the attempt and generates a report (**S10A**).

[0019] If desired, the host **20** may store the date and time an individual gains admission to or exit from a controlled area (**S9A**). A report is then created which indicates the date, time and identity of the individual (**S9B**). When the same individual exits the controlled area, for example, at the end of a shift or for a meal break, the individual exits the controlled area by placing the same predetermined epidermis on the epidermal topographical scanner **12**. An individual can exit a controlled area by placing the predetermined epidermis on an epidermal topographical scanner **12** of another terminal **10**, for example, one located inside the controlled area, that is in communication with host **20**. Normally, the scanned epidermal topographical pattern will match the stored

epidermal topographical pattern (**S7**) and the host **20** would note and store the time of the event (**S9A**). The generated report (**S9B**) should reflect the date, time and location the individual exited the controlled area. In the event the individual damaged the stored epidermis pattern while in the controlled area, the host **20** stores the time and date of attempted exit (**S7A**) and generates a report (**S7B**). An authorization code (**S11**) may be input by security personnel to permit the individual's departure from the controlled area. The authorization code also permits the individual to submit a new epidermal topographical pattern to update the database (**S13-S16**). The host **20** preferably uses the above dates, times and locations of entry and exit, over a period of time, such as a week, to generate management and payroll reports.

[0020] Figures 4 and 5 show an example of a card **90**, which is read by a terminal **100** in a second embodiment of the present invention. In order to access a controlled area, an individual is required to present a card **90** having at least one machine readable medium. Figure 4 shows the front face of a card **90** having a photograph **92** and a visible machine readable code **94**. The card **90** may also contain personal identification information such as the bearer's name, eye color, etc. The same personal identification information may be encoded in the visible machine readable code **94**. Figure 5 shows the rear face of the card **90** which includes magnetic stripe **96**. Personal identification information from the front face of the card **90** is also preferably encoded on the magnetic stripe **96**. Non-visible information may also be encoded on the magnetic stripe **96**.

[0021] Referring to Figure 6, a block diagram of a second embodiment of the present invention is shown. A terminal **100** is substituted for the terminal **10** in Figure 1. In addition to the epidermal topographical scanner **12**, display **14** and keypad **16**, the terminal **100** includes a card reader **105** for reading either visible machine readable code **94** or encoded data on the magnetic stripe **96**. The reader **105** may also be configured to read both **94** and **96**. The scanner **12** reads a portion of an individual's epidermis, preferably a fingerprint, and generates an epidermal topographical pattern. Operation of the alternative embodiment of the present invention is shown in the flowchart of Figures 7A and 7B. After the terminal **100** is activated, the program is started (**S1**) and the system is initialized, preferably automatically (**S2**). The card **90** is inserted into, or scanned by, card reader **105** (**S3**). The card **90** is read to obtain the identification information encoded thereon (**S4**). For added security, the individual may be prompted to input a personal identification code (**S5**). The display prompts the person seeking access to place a predetermined epidermis, such as a finger, on the epidermal topographical scanner **12** (**S6**). The epidermis is placed on the scanner (**S7**), the epidermis is scanned and an epidermal topographical pattern is generated (**S8**). The identification information, along with the identification code, and epi-

dermal topographical pattern are transmitted to the host **20** (**S9**). The host **20** compares the transmitted information with the information in the database (**S10**).

[0022] If the transmitted information of the individual seeking access does not match (**S10A**), the terminal **100** stores the time of attempted entry or exit. The display **14** prompts security personnel to make a personal review or investigation of the individual. A display **14** requests a security or authorization code (**S14**). If it is determined that the individual should gain access, the security guard or other authorized person enters a security code or authorization code (**S15**). If an authorization code is entered and followed by the individual's personal identification code, the individual places the predetermined epidermis on the epidermal topographical scanner **12** (**S16**), which reads the epidermis and generates an epidermal topographical pattern (**S17**). This pattern is transmitted along with the personal identification code to the host (**S18**). The host then replaces the old epidermal topographical pattern with the transmitted epidermal topographical pattern in the data base **60** (**S19**). The system then returns to step (**S3**) so that the individual can obtain access to or egress from the controlled area by repeating steps (**S3-S10**). If an authorization code is not entered, the system returns to step **S3**.

[0023] If the associated access information does not permit access at the current date and time (**S11**), access is denied (**S13**) and the system returns to step (**S3**). Each time access is denied (**S13**), the host **20** preferably stores the time of the attempt and generates a report (**S13A**). Then, the system returns to step (**S3**).

[0024] If the transmitted information matches and the associated access information indicates that access is permitted (**S11**), access is granted (**S12**) and the system returns to step **S3**. If desired, host **20** may store the date and time an individual gains admission to or exits from a controlled area (**S12A**). A report is then created which indicates the date, time of entry and identity of the individual (**S12B**). When the same individual exits the controlled area, for example, at the end of a shift or for a meal break, the individual must place the predetermined epidermis on the epidermal topographical scanner **12**. Alternatively, the individual can place the predetermined epidermis on another epidermal topographical scanner **12** inside the controlled area. If the scanned epidermal topographical pattern matches the stored epidermal topographical pattern (**S10**), the host **20** would note and store the time of exit (**S12A**). The generated report (**S12B**) should reflect the date, time and location of the individual's exit from the controlled area. In the event the individual damaged the recorded epidermis while in the controlled area, the epidermis will not match the recorded epidermis (**S10A**). The host **20** preferably stores this event. However, an authorization code (**S14** and **S15**) may be input by security personnel to permit the individual to exit and record that departure from the controlled area. The authorization code also permits the individual to submit a new epidermal topographical pat-

tern to update the database (**S16-S19**). Over a period of time such as a week, the host **20** uses this information to generate management and payroll reports.

Claims

1. An apparatus for controlling personnel movement in a controlled area, the apparatus comprising:
 - a host computing device;
 - a database operatively associated with the host for recording information for a plurality of individuals, each individual record having associated therewith an individual's predetermined epidermal topographical pattern and personal identification data;
 - a plurality of data collection terminals in communication with the host wherein at least one of the terminals includes a scanner means for inputting to the host an epidermal topographical pattern for a presented individual in a format suitable for comparison with the stored epidermal topographical pattern records; and
 - means for indicating the result of the comparison.
2. An apparatus as in claim 1 wherein at least one terminal further comprises means for inputting an authorization code and a personal identification code.
3. An apparatus as in claim 2 wherein said inputting means includes a keypad for inputting the authorization code.
4. An apparatus as in claim 2 further comprising means for replacing the stored epidermal topographical pattern with a new epidermal topographical pattern.
5. An apparatus as in claim 1 further comprising a means for reading identification information in a machine readable format.
6. An apparatus as in claim 1 further comprising:
 - means for prompting an attendant to make a human evaluation of the presenter.
7. An apparatus as in claim 1 further comprising:
 - means for changing the recorded information for an individual and associating that changed information with the individual's predetermined epidermal topographical pattern.
8. An apparatus for controlling personnel movement in a controlled area comprising:
 - a host computing device;

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a database operatively associated with the host for recording access information for a plurality of individuals, each individual record having associated therewith an individual's predetermined epidermal topographical pattern, identification information and a personal identification code; and

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a plurality of data collection terminals in communication with the host wherein at least one of the terminals includes a means for inputting to the host a personal identification code, identification information and epidermal topographical information for a presented individual in a format suitable for comparison with the stored access information.

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9. An apparatus as in claim 8 wherein at least one terminal further comprises means for inputting a new epidermal topographical pattern upon receipt of an authorization code.

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10. An apparatus as in claim 9 wherein said inputting means includes means for replacing the stored epidermal topographical pattern with the new epidermal topographical pattern in the database.

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11. An apparatus as in claim 9 wherein said inputting means includes a keypad for inputting the authorization code and personal identification code.

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12. An apparatus as in claim 8 wherein said inputting means includes an epidermal topographical scanner, and means for generating a digital epidermal topographical pattern.

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13. An apparatus as in claim 8 further comprising:

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means for transmitting said epidermal topographical information, identification information and personal identification code to said host computing device; and

means for granting access to or egress from said controlled area when said stored epidermal topographical pattern, identification information and personal identification code matches said transmitted epidermal topographical information, identification information and personal identification code, and said access information indicates that access or egress is permitted.

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14. A method for controlling personnel movement in a controlled area comprising:

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providing a host computing device;
providing a database of recorded access information for a plurality of individuals that is operatively associated with the host, each individual

record containing at least an epidermal topographical pattern associated with a given individual;
providing an epidermal topographical scanner for scanning a predetermined epidermis of a presented individual; 5
means for generating an epidermal topographical pattern based upon the scanning and transmitting that pattern to the host;
means for comparing the transmitted pattern of the presented individual with the recorded access information to determine whether the presented individual should have access to the controlled area; and
means for indicating the result of the comparison. 15

15. The method of claim 14 further comprising:

providing a means for inputting an authorization code to the host; 20
providing a means for inputting a personal identification code to the host;
providing a means for comparing the authorization and personal identification codes to the recorded access information; and 25
providing a means for modifying the recorded access information based upon a favorable comparison of the authorization and personal identification codes with the recorded access information. 30

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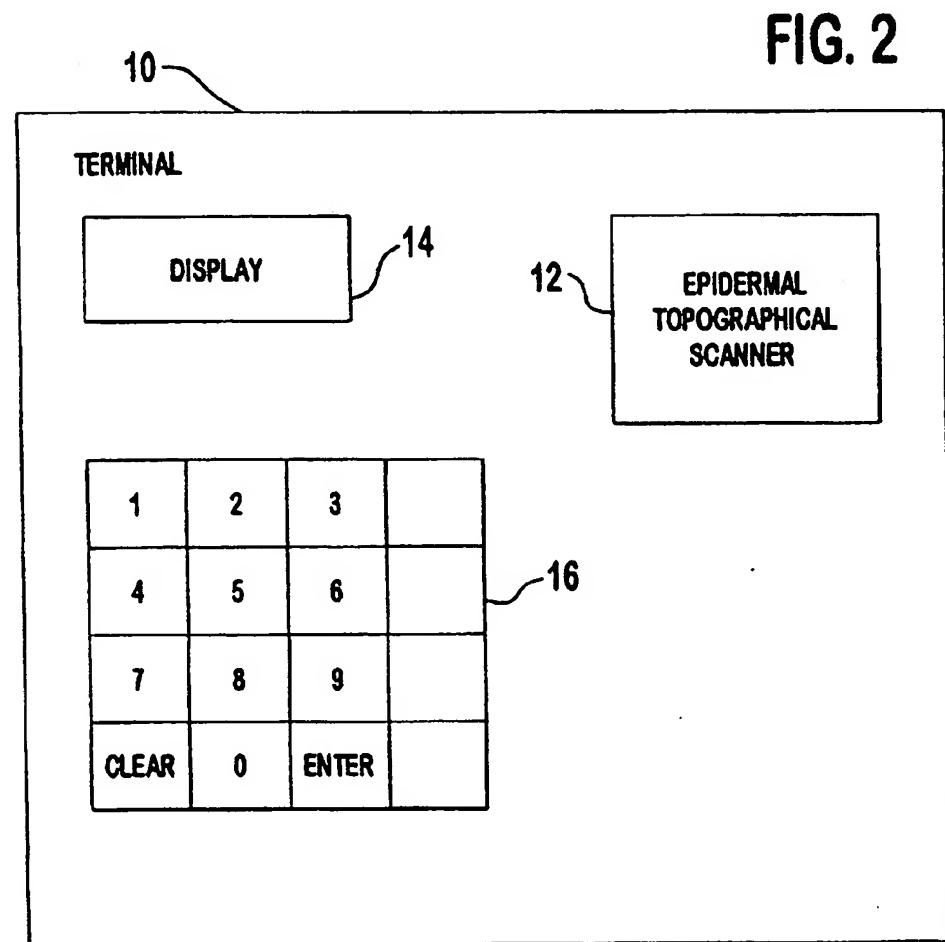
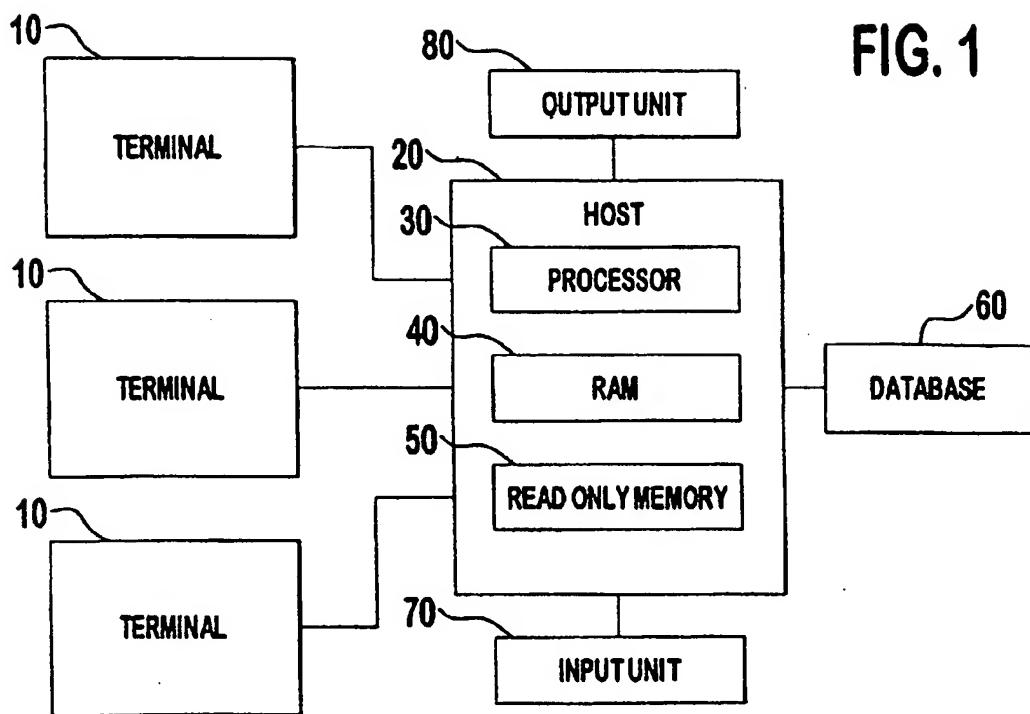


FIG. 3A

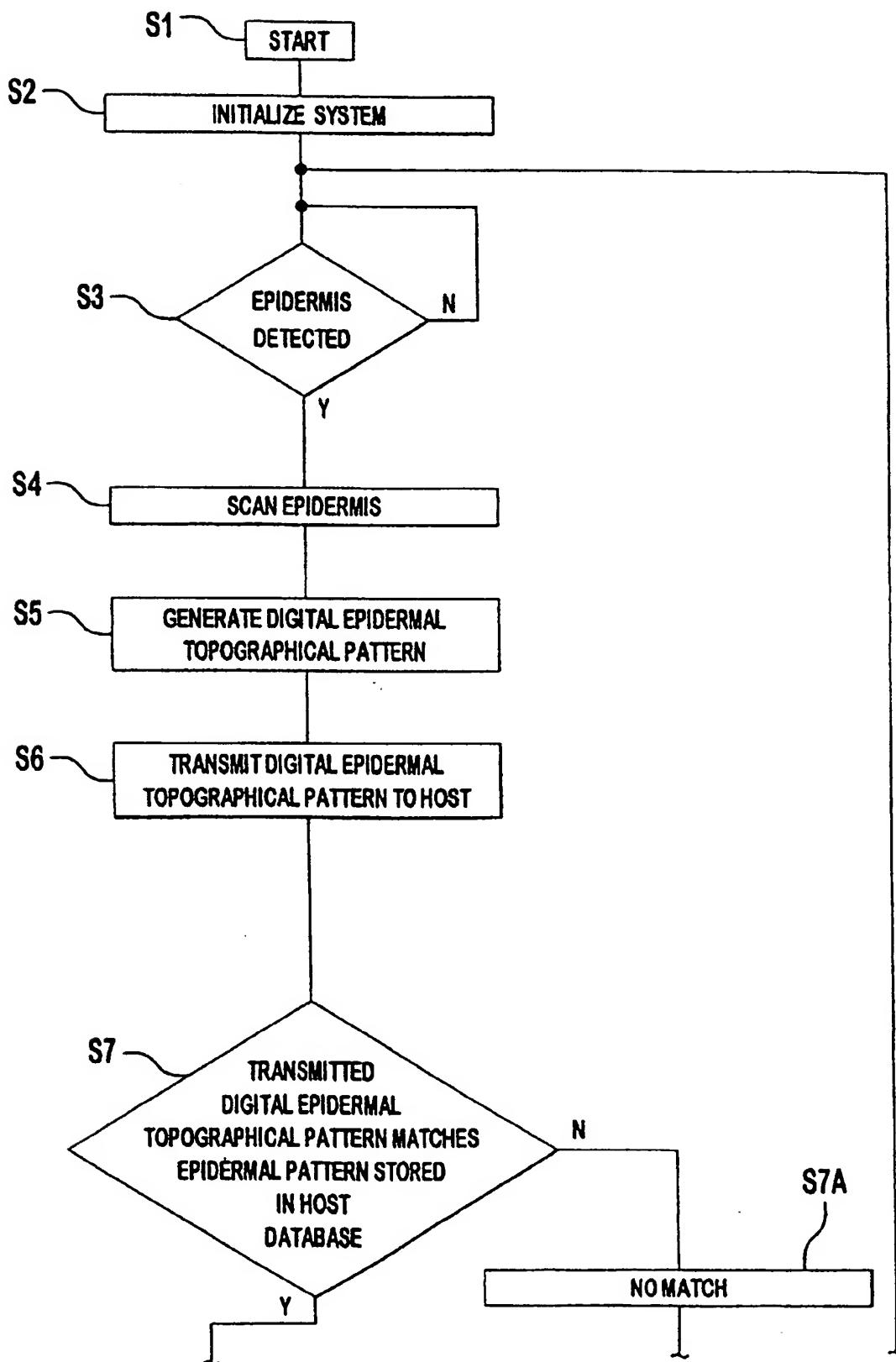


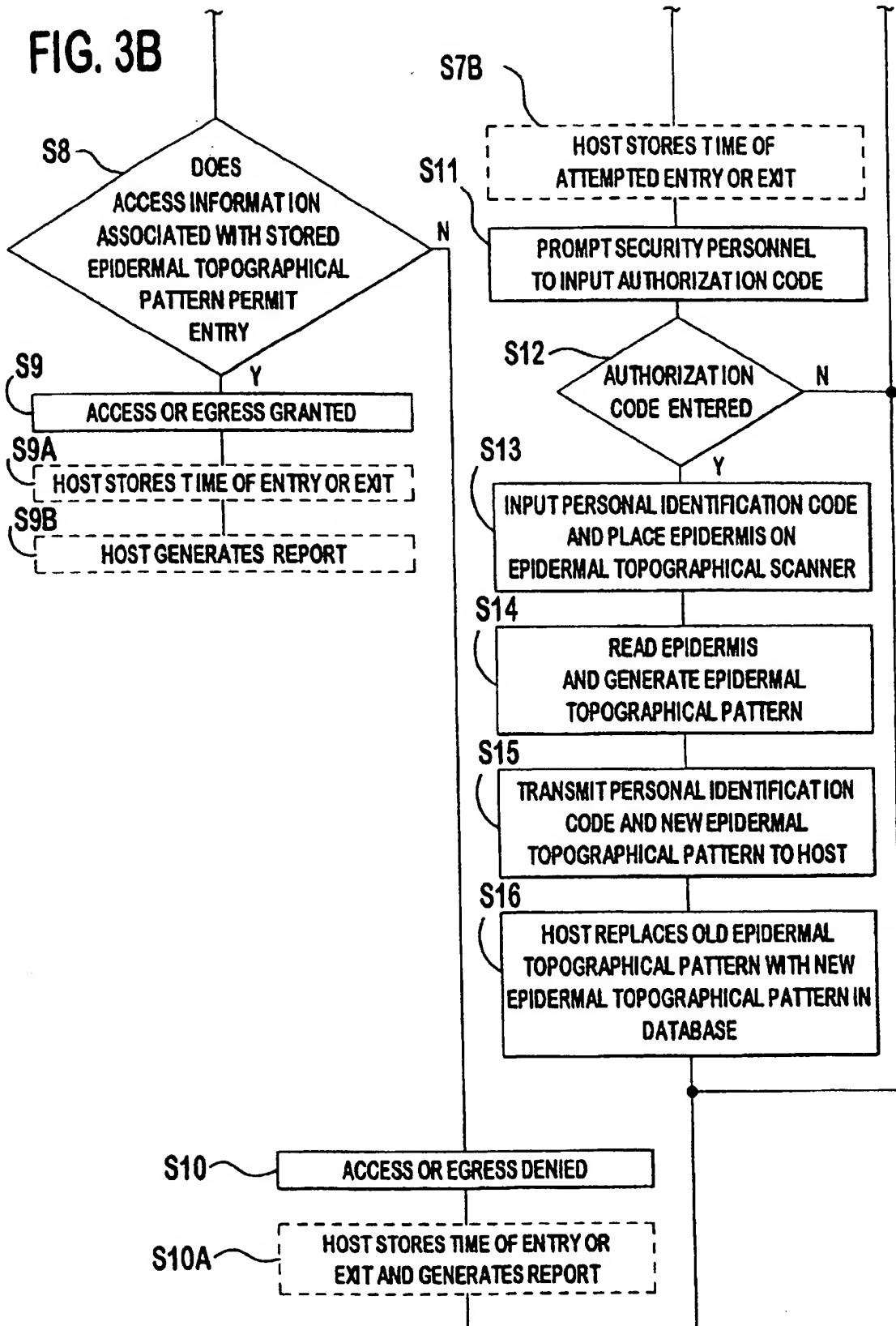
FIG. 3B

FIG. 4

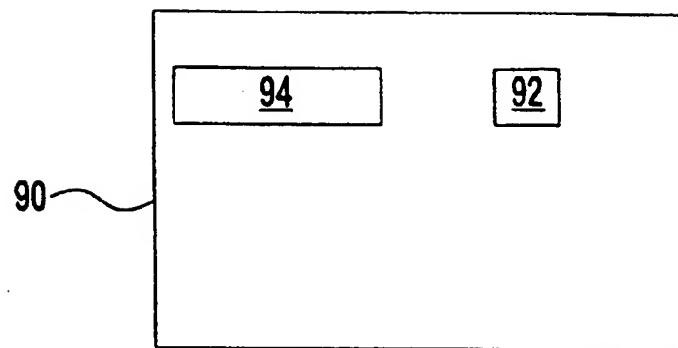


FIG. 5

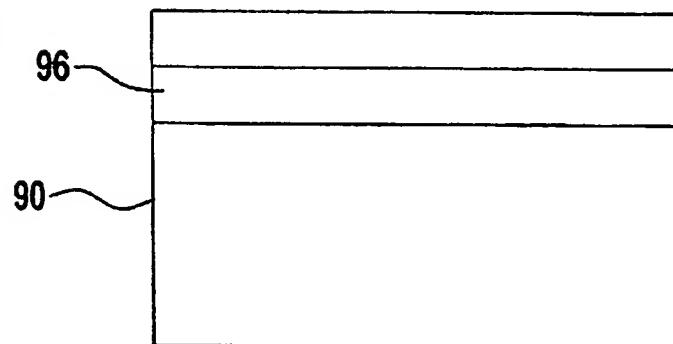


FIG. 6

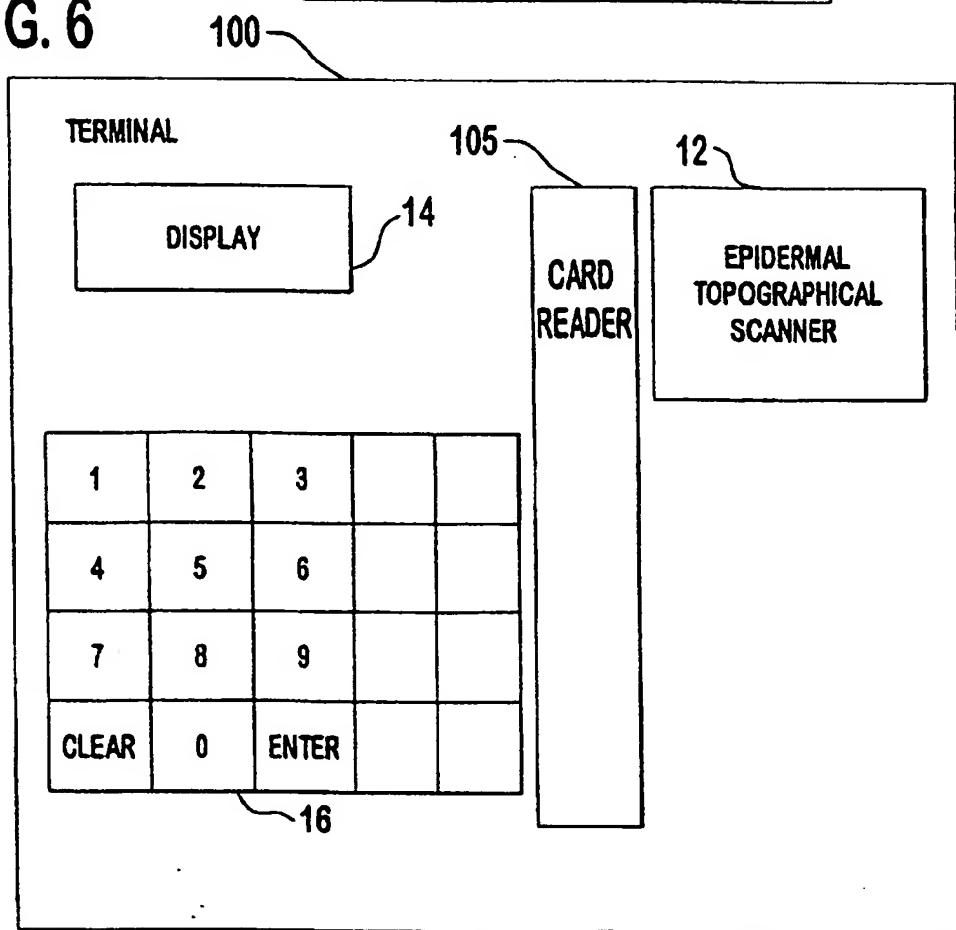


FIG. 7A

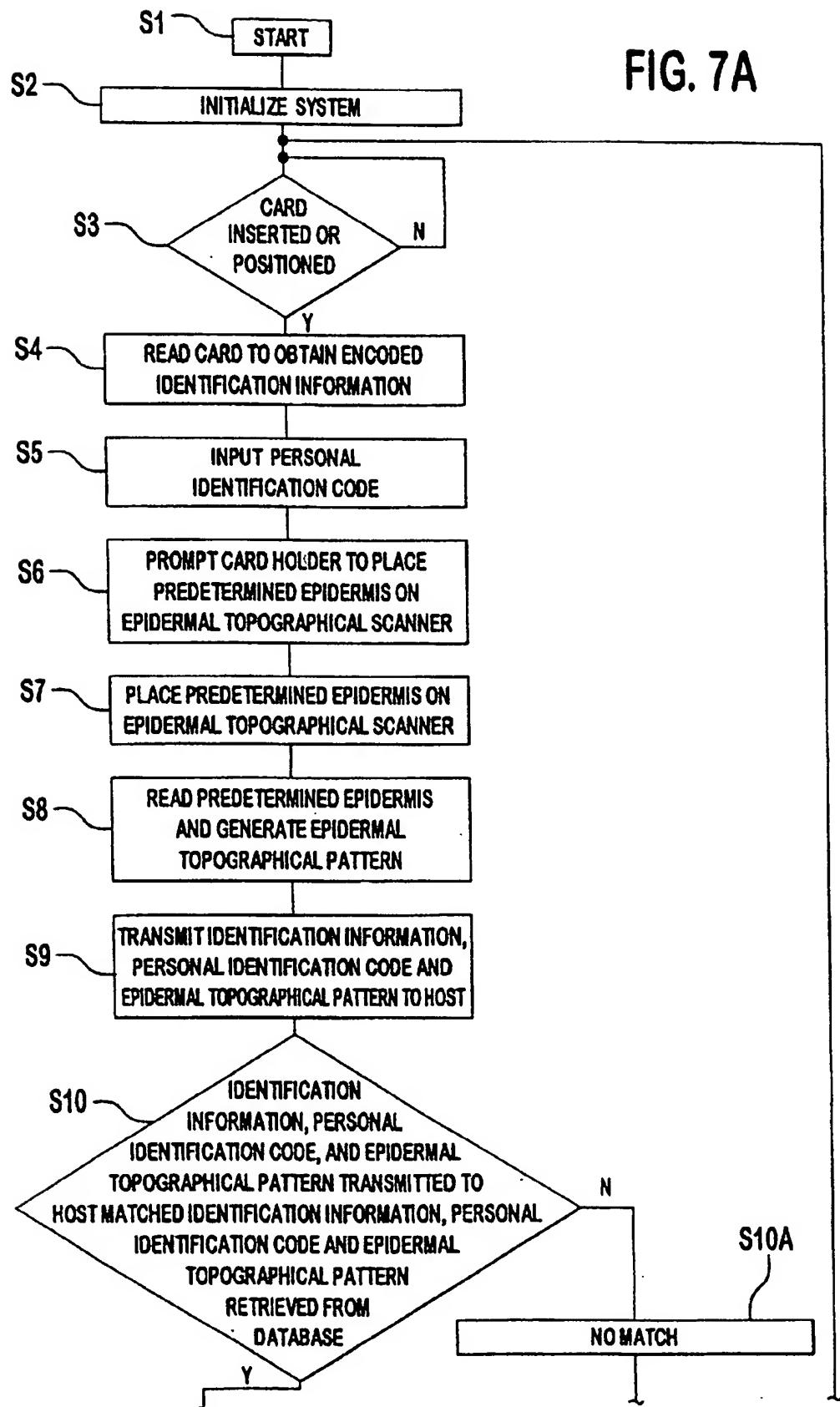


FIG. 7B

